Life and death on the coral reef: an ecological perspective on scholarly publishing in the health sciences*†

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Objective: Reflecting patterns evident in past Janet Doe lectures, the 2004 address draws on the foundations of biology to provide a model that offers insights into the advent of electronic publications and choices for the future.

Setting: The lecture sketches a picture of the fragile relationships found in complex ecosystems and illustrates how such interdependencies function in the environment of the coral reef.

Analysis: Deriving lessons from the marine world, the lecture then shifts to a description of similarities in the realm of scholarly publishing, the impact of digital innovations in the marketplace, and the controversies and choices inherent in open access publications.

Conclusions: Lessons from ecology and publishing lead to the conclusion that librarians must take action and risks in this time of dramatic environmental change.

INTRODUCTION

The invitation to join the ranks of Janet Doe lecturers comes as a profound and humbling honor. In 1968, Frank Bradway Rogers delivered the second Doe lecture [1]. At the time, he was director of the Denison Memorial Library at the University of Colorado, a position in which I now have the privilege to serve. He spoke in detail about the annual changes to the National Library of Medicine's Medical Subject Headings and the impact of those changes on a typical academic health sciences library. Rogers reported spending six weeks of his full-time effort to update subject entries in the card catalog, followed by seventeen weeks for a library assistant to complete all the physical corrections to the cards.

I remember coming to Colorado in 1985 and feeling some trepidation about meeting the man, then retired, who had such a profound impact on subject retrieval and the programs of the National Library of Medicine. Being himself, he did not hide his opinions or waste any time before trying to influence my work and decisions at Denison. I marvel at the huge differences between how he spent his time as director and my own priorities more than thirty-five years later, and yet our common objectives evidence the underlying values that bind together our profession.

In reading past Doe lectures, I observe four fairly consistent themes. First, the talk by its nature derives from the personal values, passions, and unique experience of the lecturer. To a significant degree it is a self disclosure, an intimate exposure of how one thinks, what one believes is important, and what are the innermost musings that may have been shared with a small circle of colleagues and friends, but that rarely are presented so publicly.

The second evident pattern is the intent of many lecturers to incite the audience or reader to take some specific action. As the 1994 Doe lecturer, Nina Matheson urged us to ''seize the day,'' because librarians must be agents of change [2]. Judith Messerle decried meekness and passivity, calling on us to take action to uphold our professional values [3]. In 2002, Jacqueline Donaldson Doyle noted this lecture constitutes one's opportunity to mount the soapbox [4]. The theme of

* The Janet Doe Lecture on the history or philosophy of medical librarianship, presented at MLA '04; the 104th Annual Meeting of the Medical Library Association, Washington, DC, on May 24, 2004; Frieda Weise, the 2003 Janet Doe lecturer, gave the introduction.
† During the lecture, the audience at the annual meeting enjoyed a display of dozens of underwater photographs by Werner Lissauer and images from the National Oceanic and Atmospheric Administration.

our 2004 annual meeting is ''Seize the Power,'' hence the reader should expect to encounter some haranguing in this lecture as well. I believe that we find ourselves at a critical period of combined peril and opportunity, both in the natural world and in scholarly communication. In these circumstances, the meek will *not* inherit the earth, or it may no longer be worth inheriting. Below I will outline why I fear this is the case.

Each Doe lecturer is asked to address either the history or philosophy of health sciences librarianship. The third pattern I noted in past lectures is that while some speakers revel in historical analysis of the field, others disclaim any bent in that direction and acknowledge they have taken a philosophical approach by default. I consider myself neither a historian nor a philosopher. Consequently, as is typical of me, I have chosen to bend the assignment a bit to suit my own peculiar view of the world. I will talk at some length from the perspective of *natural* history and the ways that suggests parallels in nature, the work of librarians, and our choices for the future.

In fact, this reference to biological models follows a thread that runs through a number of Doe lectures, from Martha Jane K. Zachert [5], who spoke in 1978 about ''books and other endangered species,'' to Robert G. Cheshier [6], who described the challenges and opportunities of working in the environment of a flood tide. In his 1996 lecture, Robert Braude (incidentally, another of my predecessors as director at the University of Colorado) used the natural selection of the finch as an apt metaphor for discussing the emergence of our specialized branch of the field from the general species of librarian [7]. Where Braude emphasized the role of education as a force for differentiation, I will focus on a truly biological model, the complex interdependency of a community of organisms.

My chosen approach stems from my days as an undergraduate studying biology and working in the botany department at Colorado State University, where I became imprinted with the concept of ecosystems. My approach is greatly influenced by the rampant wanderlust that runs in my family and the enriching experience of pursuing scuba diving as a personal hobby. In the fourth century, St. Augustine said, ''The world is a book, and those who do not travel read only one page.'' In keeping with his observation, I hope to read many books in my lifetime. Between my biology background and my scuba trips, I tend to see the world from a systems perspective, one with a strong ecological and behavioral framework.

As evidenced by a show of hands at the 2004 annual meeting, a preponderance of Medical Library Association (MLA) members grew up watching the television action series *Sea Hunt,* in which Lloyd Bridges portrayed fictional scuba diver Mike Nelson. This series played an important part in my life as well. Upon turning thirty-nine, I realized that I had always wanted to see up close the amazing colors and textures underwater and that if I did not progress beyond snorkeling, I would die with a large and disappointing hole in my life. By good fortune, I received personal scuba diving lessons from Werner Lissauer, a retired cardiologist who is in some ways Denver's Germanic equivalent to Jacques Cousteau. Werner learned to dive in 1941, as a young member of the Israeli navy. He learned to dive in the Mediterranean Sea at a time when life was still there to see, before we turned it into the present barren wasteland. Thanks to Werner, and often in his company, I have repeatedly sampled the world's oceans and amazing marine diversity, from the Bahamas to the Barrier Reef of Australia, from Cozumel to Cuba, from Tahiti to Tobago to Thailand.

Because I have listened to many a Doe lecture, I tried to keep in mind those unyielding conference hall chairs as I prepared my talk and audiovisuals. One model I drew on in particular was a study from the University of London that described the blueprint for the perfect box office hit. Based on a painstaking analysis of every frame in a sampling of successful films, academic researcher Sue Clayton recommended combining the following elements to ensure a winner:

- start with 30% action
- mix in 17% comedy
- add 13% good versus evil
- thrust in 12% sex, with variant exposure of body parts
- then add 10% special effects
- use a mere 10% plot and
- finally, add 8% music [8]

The typical movie-goer wants distraction and entertainment, hence the limited need to supply a strong plot. An MLA audience, however, desires and deserves more than flash. Still, hoping for maximum impact, I confess to having followed the above formula quite closely, although I abandoned the music, because I could not see how to include that in the printed *Journal of the Medical Library Association.*

THE CONCEPT OF ECOSYSTEMS

The first half of this article must begin by defining the biological structures that frame it. The word ''ecology'' first appeared in the writings of German zoologist Ernst Haeckel in the 1860s and was derived by combining two Greek words to mean ''the study of the home'' [9]. In 1957, biologist Ralph Buchsbaum observed that ''the word ecology is beginning to appear regularly in newspapers and magazines'' [10]. He posited that humankind's survival hinged on understanding what we depend on or affect directly or indirectly in our environment. He described food chains; the concept of ''mutualism,'' where organisms can live together and benefit each other; and ''ecological succession,'' where once dominant organisms are replaced by others better suited to an environment. The concept of ecological succession becomes important later in this lecture.

Buchsbaum used the simple analogy of a watch, which works properly only if every little part is in place. And he cautioned that people frequently ignore

or discard pieces of ecological systems at work in the world, overlooking the interdependence found in very complex cycles. Humans willfully rearrange the natural world, resulting in all kinds of unforeseen disturbances and imbalances. Ironically, in 1957, Buchsbaum stressed that ''the single most striking fact about seasonal change in the oceans is that at least 95% of the total marine environment undergoes no change that significantly affects the life of the seas'' [10]. However, since then, we have come to understand this is not quite true due to the cycles of El Niño and La Niña, and then there is the cumulating impact of humans. The sea is changing in very significant and worrisome ways as we meddle with and disrupt the ecosystems that keep our world stable.

Scientist and science fiction author Arthur C. Clarke is credited with saying ''how inappropriate to call this planet Earth when it clearly is Ocean.'' Seventy percent of the surface of our very blue planet is ocean, which we tend to forget as we concentrate on the human activities that take place on the much smaller land masses. Despite some modern concerns about overfishing, Buchsbaum is correct that we mostly ignore the sea and the consequences of our actions on systems we fail to understand. This perspective may be exacerbated by the Internet explosion that has nearly linked all land masses and islands into one global network, an electronic framework that skips over the open oceans as if they no longer exist. How ironic that technology draws us closer together as an international community and yet allows us to overlook what happens in the vast spaces that separate us.

Last fall, the president of the Ocean Conservancy reported on the largest volunteer effort in the world on behalf of oceans [11]. Over 391,000 individuals in 100 countries removed 8.2 million pounds of trash from coasts and shorelines. Yet, can 391,000 people out of a global population of 6.4 billion truly clean up 70% of the planet? As we become more closely bound together by the Internet, can we afford to neglect the natural structures that shape our daily existence?

Ecosystems present a useful model to remind us of the complexities and interdependence of many factors in the modern world, be they natural rhythms or human interactions. As a discipline, ecology does not exist in isolation but is inextricably bound up with economics, the study of the allocation of scare resources in society as a means to satisfying human wants or desires [12]. Those scare resources often come from the natural world. The remainder of this lecture focuses on how humans impact a particular ecosystem, the coral reef, and what that may tell us about the current turmoil in scholarly communication and the advent of open access publishing.

THE NATURE OF THE CORAL REEF

What is the coral reef, and why is that ecosystem important to us? Corals evolved more than 500 million years ago and began to literally build and change the face of the planet [13]. Corals are tiny plant-like animals that require clean, clear water and sunlight to survive, and, in return, they provide the foundation for an immensely rich, complex, and fruitful food chain and recycling system. Corals are both hard and soft. Each coral polyp contains photosynthetic algae that provide food and oxygen to the polyp in exchange for a safe shelter and convenient access to nitrogen and other waste products. For hard corals, when individual polyps die, the next generation builds on the skeleton left behind. The reef feeds on solar energy and recycles almost everything, including the many chemicals and materials we deposit in the ocean in one way or another. The reef itself creates almost no waste, because its many inhabitants use all the byproducts in this complicated chain.

In fact, the coral reef is the planet's most successful engineering mechanism of all time. The 400 species of coral have produced the largest artificial structures on earth. In *The Voyage of the Beagle*, Charles Darwin marveled that:

> We feel surprise when travelers tell us of the vast dimensions of the pyramids and other great ruins, but how utterly insignificant are the greatest of these, when compared to these mountains of stone accumulated by the agency of various minute and tender animals! [14]

Australia's Great Barrier Reef began to form about 18 million years ago and is the largest such system [15]. It extends over 1,250 miles, about the length of the coastline of the western United States. Worldwide, there are approximately 360,000 square miles of living coral reefs [16], about the size of Texas and Colorado together. Reefs occupy less than 1% of the ocean floor, yet they provide a home for more than 25% of all marine organisms [17]. They absorb enough carbon dioxide from the atmosphere to help regulate the global climate. Scientists cannot agree whether the reef or the rain forest forms the most complex environment, but they do agree how vital both are to our survival, and yet both remain poorly understood. The Great Barrier Reef is the largest structure on earth created by living organisms. Not bad for tiny animals that possess a simple nervous system but lack a brain!

These tiny corals manage to make such large homes through lots and lots of sex. Most, although not all, corals are hermaphrodites, producing both eggs and sperm. To maximize fertilization, concurrent mass spawning occurs over large sections of ocean. In one or two nights, entire coral reefs spawn. On the Great Barrier Reef, as many as 200 species of coral may all release cells on the same night [13]. Slicks of eggs and sperm cover the surface of the sea for miles, and water visibility declines. It is the most spectacular sex act on the planet.

As a healthy coral reef grows, it provides an essential platform for other marine organisms to come together in many different relationships. ''Symbiosis'' exists when two species live together or interact in some way, and several subdivisions of this type of arrangement exist [13]. For example, coral polyps and algae display ''mutualism,'' where both benefit from

each other. We are all aware of ''parasitism,'' where one species exploits another. Today, faculty members and librarians protest apparent parasitism in the publishing world, and some of us are taking action to alter the balance of power and foster greater mutualism.

On the reef, tension between competition as a means of ensuring survival versus some form of cooperation as an alternative strategy for flourishing is constant. Competition sometimes results in increased specialization and sometimes encourages biodiversity as a way to improve the probability of survival in the face of unpredictable future change or large environmental flux [13]. In the publishing realm, rigorous competition also exists between various individuals and organizations, and we have seen the emergence of ever more specialized biomedical publications. Electronic publishing promises to result in more biodiversity, but survival is always a chancy thing. We think of death primarily as an event that involves individuals, but, when major imbalances occur in the ocean, they can lead to the loss of a whole species or failure of the entire ecosystem. Consider global pressures threatening the coral reef parallel to disruptions to the system of scholarly publishing.

THE REEF IMPERILED

Given the time limits on this lecture, I have chosen to focus on the Great Barrier Reef, because it represents both a huge ecosystem and a major economic resource. More than 1.5 million people visit the Great Barrier Reef each year, bringing nearly $3 billion to the tourism economy of Australia. Recreational fishing generates $160 million a year and commercial fishing another $80 million [18].

In 1975, the Great Barrier Reef Marine Park Act created protections because the future of the reef was imperiled by proposed oil drilling, limestone mining, and shipping [19]. In 1981, World Heritage status was conferred by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to provide new protective legislation [19]. In 2004, the national marine park was extended to encompass nearly a third of the entire reef system. Clearly, the government and citizens of Australia value the reef and have acted to preserve it, yet economic interests and population growth continue to challenge that stance, and the ocean is affected by all nations.

Take, for instance, the release of mercury into the environment from air pollution and runoff in many countries. Authors of recent studies advise pregnant women to greatly limit consumption of canned tuna and eight other popular fish because of the potentially harmful effect of mercury concentrations in large marine animals [20]. Other fish are about to become toxic as organisms lower on the food chain become repositories for our pollutants. Perhaps we will cease to deplete the oceans when we become unable to eat any of its inhabitants.

One study predicts that, despite legislative protections, the coral reef system may be completely dead in fifty years, based on stresses we have put upon it [17]. Serious damage to coral reefs comes from five major factors, most of them tied to humans [19]. First, coral is dependent on water quality and cannot live where sunlight is obscured or silt is deposited on the polyps, thus choking them. As the world population grows, so too do we see an increase in the amount of nitrogen, other chemicals, and topsoil carried into the ocean. Fertilizers encourage the growth of algae and other plants that smother coral. Soil in rainfall runoff blankets the reef in a layer of stifling muck.

Climate change represents another major threat to the reef systems. Coral is a surprisingly delicate animal, easily killed by the touch of a finger and tolerant of a rather narrow temperature range. Warm water coral develops best in water temperatures between 18 and 22 degrees centigrade, or 64 and 72 degrees fahrenheit [21]. Human use of hydrocarbon fuels is contributing to global warming. Records beginning in 1911 suggest that the water around the Great Barrier Reef has warmed by 1.2 degrees centigrade, over a quarter of the zone of tolerance for coral [19]. In recent years, many areas of the world have experienced additional large increases in water temperature due to the El Niño and La Niña cycle, causing serious die-off of coral. A third cause of destruction to the coral reef is commercial fishing. Canadian biologist Ransom Myers says, ''we are in massive denial and continue to bicker over the last shrinking numbers of survivors, employing satellites and sensors to catch the last fish left'' [22].

Tourism plays a fourth role in threatening the health of the coral reef. Visitors touch coral, bring pollutants, use boats that churn up sediment, and even break off and take home souvenirs. The last threat to the reefs comes from our ignorance: We lack knowledge about the full extent of marine ecosystems and the ways they function. We lack knowledge about how human activity and byproducts impact and undermine that ecology. In January of 2004, *Travel and Leisure* magazine advised its readers that they should travel soon to enjoy twelve places that are seriously endangered, and the Great Barrier Reef is one of the twelve [23]. Ironically, the magazine notes that the Great Barrier Reef suffers from overdevelopment and the onslaught of tourism, then suggests that readers should quickly join the throng of visitors before it is too late!

ECONOMIC MODELS AND THE REEF

Although largely out of our sight, coral reefs are important both because they contribute to the balancing of many factors in the global ecosystem and because they have a direct impact on the economy. Around the world, reefs generate an estimated $300 billion each year in products and services. In the United States alone, tourism to reef areas generates more than $17 billion annually [17]. In the realm of biomedicine, the reefs hold tremendous potential for the discovery of new therapeutic agents. When coral reefs die, we lose this source of promise, and tourism disappears along

with the previously abundant fish populations [24]. We need to preserve this natural resource for economic as well as ecological reasons.

Writing about environmental economics, Clement Tisdell observes that ''monopolists are sometimes said to be a conservationist's best friend'' [12]. This conservation comes from their profit motive, which causes them to restrict the supply of resources to drive up the price in the market. Tisdell counters this beneficent role by pointing out that a monopolist may excessively restrict the supply, may use up the resource in a different manner, and may thwart conservation by wielding undue political pressures. Further, in search of greater revenue, the monopolist may fuel new customer demand for the resource in question, resulting in depletion. Tisdell believes we fail to appreciate the economic value of the natural world and of biodiversity.

Humans are using up nonrenewable resources, such as oil and coal, at a rapid rate and, in the very long term, will need to rely on renewable biological resources for energy as well as food. Reefs support the fish populations that feed the world. The United Nations has stated that the world gets 17% of its animal protein from fish [25], and the international community holds huge, ineffectual conferences to discuss the dwindling supply. Nearly three-quarters of the world's fish stocks are now believed to be overfished, because they are poorly protected [26].

When natural resources are widely available and ownership is unclear or unprotected, exploitation frequently occurs. Take, for instance, the work of Colin Hunt, a professor of strategic management in New Zealand. Describing property rights in the Pacific, he states that unsustainable use of marine resources stems from two factors [27]. First, the absence of designated rights of ownership produces a free-for-all situation that Hunt terms ''open access,'' where individuals or organizations can grab whatever they wish and exploitation can result.

Similar overuse results from lack of enforcement of property rights. When anyone can scoop up unlimited quantities of fish from the open ocean, depletion occurs [22]. Extending this biological model to publishing, similar ownership complications arise. We can speculate that when authors hold the copyright to their own works, a busy biomedical scientist may have great difficulty enforcing those rights in an electronic world that facilitates digital copying and redistribution.

Hunt concludes that problems with open access and environmental exploitation necessitate attention to protect the best interests of the entire community [27]. He believes governments must provide public policies and systems to ensure sustainability. In April 2004, the US Commission on Ocean Policy came to essentially the same conclusion. Its preliminary report advises that we must shift to ecosystem-based management of our marine resources, setting policies and implementing practices that look at the complex interrelationships of many factors [28]. Time has proved that it does not work when we focus on individual pieces of the environment, such as certain fish populations, water quality, or other components that we attempt to disconnect from the rest of the system.

While I agree with Hunt that government can help address some of the problems of our oceans, individual action is also required. For example, MLA members can make a difference by using sustainable design principles as we build new libraries or renovate old ones. We can recycle and buy products from ecologically conscious companies. We can insist our politicians take a long-term view and enact legislation for the future of the global ecosystem. We can support ecological groups, such as the Ocean Conservancy or the Coral Reef Alliance.

CONCLUSIONS FROM THE MARINE ENVIRONMENT

We can learn a great deal from marine ecology to apply to the current environment of health sciences librarianship, but three concepts hold particular importance. First, complex interdependencies are the norm in the natural world and in publishing. Human nature too often causes us to cling to a narrow perspective or to oversimplify the dynamics of our work environment, but overlooking the intricacies of complex systems holds personal and professional danger. Ecosystems evolve over time, yet when multiple changes occur simultaneously, their interaction often makes it impossible to predict exactly what cumulative results will emerge. We cannot afford to take a narrow or simplistic view.

Second, balance is key, especially when people become involved. Wide open access to marine resources results in overfishing and other abuse, in the same way that Americans destroyed the wild bison herds of North America. At the other extreme, overly controlled ownership denies the rights of others or may make it economically impossible for other people to use resources.

Finally, humankind has a tremendous impact on the coral reef, much of it negative and some of it entirely unintended. Passiveness on our part will ensure undesirable or catastrophic consequences. Many current MLA members are ideological children of the 1960s, a period of incredible energy and social activity. We need to tap that latent activist drive, to join organizations, to vote, to contribute, and to take action consistent with our values for the survival of our world.

SCHOLARLY COMMUNICATION IN A PERIOD OF R/EVOLUTION

That call for action needs to be focused not only to prevent the imminent destruction of the oceans, it must be aimed at the opportunities and threats in the realm of scholarly publishing. Print-based publications have survived and prospered for centuries, and the production of paper products is not yet declining. In the world of scientific journals, however, recent economic crises and user demand have pushed librarians to rapidly forego print in favor of electronic-only ac-

cess. Ready or not, we have turned a very major corner, and the future remains unclear. Where once we were sailing on a predictable if not calm sea, we now find ourselves in the midst of a raging typhoon of unknown duration, and MLA members are divided in our opinions about what to do or not to do.

Management guru Warren Bennis says that leaders are all too often ''thwarted by an unconscious conspiracy to preserve the status quo'' [29], and many would say that describes those faculty members who would like to ignore electronic publishing and the new possibilities it presents. Some faculty and librarians actively strive to sustain the status quo, often in direct conflict with those seeking to push change through promulgation of new online journals. We need to convince our fellow librarians and faculty colleagues that change is essential, it is in their best interest, and it merits action. At the moment, however, we are not all on the same page and different perspectives are clashing, because change causes everyone to feel threatened.

Talk about a complex system in distress! Symbiosis ties us to each other, but change menaces those ties. After centuries of stability, a radically new digital creature has emerged in the publishing ecosystem, more powerful than any El Niño and more certain to permanently rewrite the seascape. Electronic publications are transforming our lives and work places. Suddenly, we are faced with dire questions of survival. Who are the most critical players in the publishing ecosystem, those whose death would speed the demise of the entire structure? It seems clear that authors can claim this niche, but what about librarians and for-profit publishers? As the water temperature rises, which creatures will adapt and evolve, and which will die off like the fragile coral polyp?

Libraries, of course, are under severe economic stress, and some have turned belly up. For decades, monopolies in scientific, technical, and medical publishing have weakened the buying power of our institutions during a period when we had very limited options for responding. Like a swimmer who sees the dorsal fin of an approaching shark, we could see the inevitable result of rising prices and declining budgets. In the purely print era, we begged for more money or canceled more journals each year. Circumstances have changed, however. Electronic publishing promises to reinvent the rules of today, just as the printing press brought on the scientific revolution of the Middle Ages. With the advent of HighWire Press, the Scholarly Publishing and Academic Resources Coalition, PubMed Central, BioMed Central, BioOne, the Open Archives Initiative, and the Public Library of Science comes the chance to transform scholarly communication in very fundamental ways. The *Chronicle of Higher Education* has recognized that we are at a time of great uneasiness and little certainty, ''on the battlefield of a war over scientific publishing'' [30].

A surprising number of individuals purport to be able to predict the outcome of this war, however. They seem assured that certain endeavors and models are bound to fail, while others prevail. I would note, perhaps somewhat cynically, that, as individuals and as a society, we really have a deplorable record when it comes to predicting the future and especially the impact of new technology. I have lived through the pronouncements that television would mean the death of radio and attendance at sporting events, inexpensive videocassette recordings would cause the death of movie theaters, and microfilm would be the sure-fire medium of tomorrow. Who knew that gopher technology would come and go in such a flash? I am skeptical of any predictions at this point, and I suspect the final outcomes in publishing are likely to be different than what anyone describes today.

As mentioned earlier, Buchsbaum described ecological succession, or replacement of one organism by another better suited to the environment. It appears improbable to librarians that print will entirely disappear, yet digital access and delivery continues to eclipse paper as the medium of speed and convenience. Scientists hunger for fast access to knowledge and fast dissemination of their own research, and online distribution is indeed better suited to fulfill these needs. Ecological theory predicts success for the new digital life form, and that is what we see playing out.

As I wrote this lecture, I quickly lost the ability to keep track of, let alone read, the tsunami of articles and news items about electronic journals and the emergence of ''open access'' publications [31–35]. The *Wall Street Journal* included open access publishing as one of the ten most important health stories of 2003 [36]. Considerable controversy swirls around this category, and many see it as a direct threat to the monopolies and high profit margins of for-profit publishers. The Bethesda Statement on Open Access Publishing defines such publications as those that meet two conditions:

> 1. The author(s) and copyright holder(s) grant(s) to all users a free, irrevocable, worldwide, perpetual right of access to, and a license to copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose, subject to proper attribution of authorship, as well as the right to make small numbers of printed copies for their personal use.
> 2. A complete version of the work and all supplemental materials, including a copy of the permission as stated above, in a suitable standard electronic format is deposited immediately upon initial publication in at least one online repository that is supported by an academic institution, scholarly society, government agency, or other well-established organization that seeks to enable open access, unrestricted distribution, interoperability, and long-term archiving. [37]

Open access and related publications are beginning to have a huge impact on the print world. They are being cited as widely and used even more frequently than print journals for the same subject disciplines [38]. If ever we had a chance to help break the old mold and design a new one for the future, this is that time. The free market demonstrates the continual failure of many would-be commercial firms. It appears that electronic publishing may well reduce the stran-

glehold of monopolies and, at least for a time, restore a freer free market. MLA members are key players in that marketplace, and we are more than mere buyers. By working with faculty colleagues, we can play a role in controlling the supply of resources to various publishing vehicles as well as the way they are accessed. If we do not take a part in this revolution, we will surely be its victims.

The publishing ecosystem might not be as complicated as the interwoven life of the coral reef, but numerous organisms significantly affect its balance. Alas, the reef has no information-management function, only hard-wired instinct and vulnerability to a myriad of environmental dynamics and dangers.

In the publishing system, information management is becoming more muddled. Publishers do not simply print and disseminate information; now they provide online indexes and retrieval interfaces that supplant similar efforts by indexers and librarians. They stake out their territory by spinning convoluted licensing agreements, and they gobble up the smaller fish around them. They deliver full text to the user's desktop and market directly to that user. They re-massage existing electronic articles into new clusters and products that appeal to the appetites of new markets. In short, they aggressively seek to solidify their position in the marketplace and strengthen their control of scholarly articles as resources, thus accelerating the downward spiral where availability becomes ever less affordable.

With this profound change in the environment, authors flounder. Where it was easy to give publishers the burden of copyright protection, it will be time consuming to accept individual responsibility for managing one's own intellectual property in the very busy digital world. At the same time, the faster turn-around of review for open access publishing and greater citation of one's work might be powerful pheromones to the scientist. More rapid feedback and publication may be just the allure authors cannot resist, and librarians can dangle this lure in front of them. Once a critical mass of authors begins to submit manuscripts to open access publications, the entire system will shift until the next major evolutionary breakthrough starts the cycle of change all over again. Librarians should not be fooled into thinking we will return to a long period of publishing stability. The pace of technological change continues to accelerate, and electronic formats will not settle down for more than a brief period.

TAKING ACTION

If we accept the application of a biological ecosystem as a model that aptly fits the publishing world, we must pay attention to the chain of interdependencies in that model and not just focus on one factor, such as open access versus for profit. We must acknowledge the complexities, our incomplete understanding of the fragile dynamics, and the danger of well-intended but ignorant meddling. How often have we been amused or offended by faculty who grow impatient with information access problems and who then insist there is a quick and immediate fix that librarians have been too blind to see? Such simplistic solutions often stem from incomplete information and a myopic vision of what is important or what is useful. Librarians are not happy when users try to bully us with some flawed and short-sighted solution, and we can expect others to respond in like fashion if we are the ones guilty of proposing a radical change, apparently based on our own self-interest.

Serving on the library advisory board for the *New England Journal of Medicine* has taught me a great deal about the realities of publishing and introduced me to things I had never before considered. We must understand and acknowledge the factors that drive society and for-profit publishers and the behaviors that produce an irrational or combative response because those factors feel like threats to the other party. And we must recognize that the food chain is what it is. Various creatures play essential roles in that chain, and the chain may break down completely if certain functions do not occur. The shark plays a useful part, and we should not expect it to turn into a delicate damsel fish just because that would be more convenient for us.

MLA's members need to become better informed about the whole process of scholarly publishing, from all sides of the process. We need to talk more with faculty colleagues, administrators, and even publishers. We need to reject overly simplistic solutions. We also need to craft persuasive arguments that honor the perspectives of others and that focus on common principles and desired outcomes that will allow us to reach agreement on how to attain those outcomes. Mutualism involves reciprocal benefit, something rather close to the values of our profession. Publishing is undergoing both evolution and revolution all around us, and we must be thoughtful as we both reshape and adjust to the new environment.

Braude's 1996 Doe lecture gives us hope that librarians possess the essential adaptability required in this digital onslaught [7]. And we have other invaluable assets. In his book, *Information Ecology,* organizational strategist Thomas Davenport talks about the continual evolution in information, scoffs at the ineffectiveness of libraries as passive repositories of printed information, and summarizes the attributes of the ideal information staff [39]. Not surprisingly, Davenport's preferred attributes mirror much of the essential knowledge and many of the essential skills MLA advocates for and imparts to its members: knowledge of the basic business and the organization, knowledge about diverse sources and uses of information, skill with information technology, political savvy and leadership, and interpersonal skills.

None of these attributes allow passiveness; all require action on the part of the individual. Writing in the March 2004 issue of the *Chronicle of Higher Education,* a dean from the University of Illinois at Chicago urges us all to be much more assertive. Dean Stanley Fish confesses he has been very vocal about elected

officials and decisions makers in higher education, calling them ''ignorant, misinformed, demagogic, dishonest, [and] slipshod.'' Fish says that ''campus administrators have been diplomatic, respectful, conciliatory, reasonable, sometimes apologetic, and always defensive, and they would have done much better . . . if they had been aggressive, blunt, mildly confrontational, and just a bit arrogant'' [40].

Librarians share that predisposition to reasoned discourse, and decades of distress over serial pricing have gotten us nowhere. When interviewing guests who seem trapped in a cycle of repeatedly ineffective behaviors, popular television psychologist Dr. Phil asks, ''And how is that working for you?'' The answer, of course, is that the described behavior most definitely is *not* working, and the person needs to try another technique.

In the present environment, pricing schemes are in flux and many volatile factors affect the environment. Personally, I did not have much at stake when VHS and Betamax versions of videorecording technology were fighting to the death, but the publishing realm is our particular ecosystem and we must take action and risks. Coral polyps are brainless and spineless. Librarians cannot afford to be either.

CONCLUSION

Past Doe lecturers have challenged us to take action and alter our world. As Braude noted in 1996, health sciences librarians have evolved to better fit our niche [7], and coral demonstrates the danger of being unable to adapt. In 1980, David Kronick admonished us to intervene in the publishing behaviors of scientists [41], and now we have a compelling reason and an unprecedented opportunity to do just that. We have the chance of our professional lifetime. Let's not let it slip by.

At the start of this lecture I commented on some ties and themes that run through the Doe lectures. Let me end just as Cheshier [6] did in 1981 with a quote he borrowed from Shakespeare's *Julius Caesar*:

> There is a tide in the affairs of men which, taken at the flood, leads on to fortune;
> omitted, all the voyage of their life is bound in shallows and in miseries. . .
> We must take the current while it serves or lose our ventures.

So, I entreat and challenge you to take an active part in preserving the marine environment that makes planet Ocean a habitable home today and that will determine our survival into the future. I entreat and challenge you to take an active part in transmuting the information environment that supports our professional life. So much is at stake, and it truly is time to seize the power.

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